Simultaneous Enhancement of Electrical and Thermal Conductivity in Graphene through Excitation of the Etheric Longitudinal Mode

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Within the framework of the *Quarkbase Cosmology*, electromagnetic and transport phenomena arise from longitudinal pressure waves in an etheric medium described by the scalar field $\Psi(\boldsymbol{x}, t)$. When an excitation in the terahertz or mid-infrared range (10–60 THz) couples resonantly to the longitudinal mode of this field, the coherence of both charge and heat carriers in graphene increases simultaneously. The predicted result is a reversible and correlated enhancement of the electrical conductivity σ and the thermal conductivity κ, a distinctive signature of the etheric longitudinal mode acting as a unifying coupling channel.

THEORETICAL FRAMEWORK

The etheric field Ψ obeys the stationary equation of the Quarkbase theory [1]:

$$(\nabla^2 - \lambda^{-2})\Psi = -\alpha \sum_i \delta(\boldsymbol{x} - \boldsymbol{x}_i), \tag{1}$$

where λ is the characteristic pressure screening length and $c_\Psi = \sqrt{\beta/\rho_p}$ the propagation velocity of longitudinal disturbances. In planar systems such as graphene, periodic strain patterns of period L define a confined cavity mode with frequency

$$\omega_\Psi \simeq \frac{\pi c_\Psi}{L}. \tag{2}$$

The coupling between the etheric field and the charge or heat currents is described by

$$\mathcal{L}_{\text{int}} = -g_e \Psi \, \nabla\cdot\boldsymbol{J}_e - g_q \Psi \, \nabla\cdot\boldsymbol{q}, \tag{3}$$

where $\boldsymbol{J}_e$ and $\boldsymbol{q}$ are the electric and heat flux densities. Near resonance ($\omega \approx \omega_\Psi$), the field susceptibility is

$$\chi_\Psi(\omega) = \frac{A}{\omega_\Psi^2 - \omega^2 - i\Gamma_\Psi \omega}, \tag{4}$$

with A the mode strength and Γ_Ψ its damping.

RENORMALIZATION OF SCATTERING RATES

The coupling to Ψ modifies the carrier scattering rates as

$$\gamma_e(\omega) = \gamma_{e0} - g_e^2 \Im\chi_\Psi(\omega), \quad \gamma_q(\omega) = \gamma_{q0} - g_q^2 \Im\chi_\Psi(\omega), \tag{5}$$

increasing the relaxation times $\tau_{e,q} = 1/\gamma_{e,q}$. Hence,

$$\frac{\Delta\tau_{e,q}}{\tau_{e,q}} \propto \Im\chi_\Psi(\omega) = \frac{A\Gamma_\Psi \omega}{(\omega_\Psi^2 - \omega^2)^2 + \Gamma_\Psi^2 \omega^2}. \tag{6}$$

In the linear response regime,

$$\frac{\Delta\sigma}{\sigma} \approx \frac{\Delta\tau_e}{\tau_e}, \qquad \frac{\Delta\kappa}{\kappa} \approx \frac{\Delta\tau_q}{\tau_q}, \tag{7}$$

and both enhancements share the same Lorentzian dependence on frequency:

$$\boxed{\frac{\Delta\sigma}{\sigma}, \frac{\Delta\kappa}{\kappa} \propto \frac{\Gamma_\Psi^2}{(\omega - \omega_\Psi)^2 + \Gamma_\Psi^2}}. \tag{8}$$

PREDICTED CORRELATED RESPONSE

This relation implies a simultaneous and spectrally narrow increase in σ and κ, centered at ω_Ψ. The correlation $r(\Delta\sigma, \Delta\kappa)$ approaches unity since both follow the same $\Im\chi_\Psi$ profile. The resonance frequency scales inversely with the resonator period:

$$\omega_\Psi(L) \propto \frac{1}{L}. \tag{9}$$

EXPECTED MAGNITUDE

For realistic parameters $Q = \omega_\Psi/\Gamma_\Psi \sim 10$, coupling strengths $g_{e,q} \sim 10^{-2}$ and moderate pump fluences, the expected variations are

$$\Delta\sigma/\sigma \simeq 0.5\text{–}3\%, \quad \Delta\kappa/\kappa \simeq 0.5\text{–}2\%. \tag{10}$$

These changes exceed the noise level of standard four-probe and time-domain thermoreflectance measurements, enabling direct experimental verification.

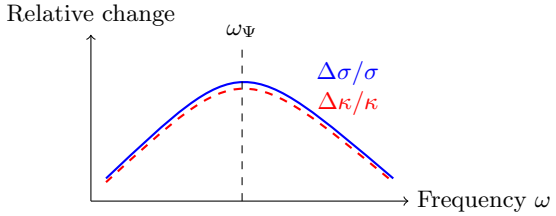

FIG. 1. Common Lorentzian peak of $\Delta\sigma/\sigma$ and $\Delta\kappa/\kappa$.

CONCLUSION

Excitation of the etheric longitudinal mode in graphene is predicted to simultaneously enhance electrical and thermal conductivities by increasing the coherence of charge and heat transport through a common pressure-field mechanism. The effect is resonant, reversible, and characterized by a unique correlation between σ and κ. Its observation would constitute direct evidence for the Quarkbase description of the etheric plasma as the physical substrate underlying electronic and thermal conduction.

[1] C. Omeñaca Prado, "Genesis Quarkbase: Field Foundations of Etheric Cosmology" (2025).